

Observations on the Habits of Ants, Bees, and Wasps.—Part IV.
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(PLATE XVII.)

ANTS.

IN my last paper on this subject (Journ. Linn. Soc., Zool. vol. xii. p. 445) I recorded some experiments showing the singular reluctance of Ants to let themselves drop even for a very short distance, and their want of ingenuity in bridging over chasms. Since then I have varied the experiments in the following manner.

Want of ingenuity in crossing Chasms.

I filled a saucer (woodcut, fig. 1, S) with water and put in it a block of wood (W), on the top of which I fastened a projecting wooden rod (B), on the end of which I placed a shallow glass cell (A P) containing several hundred larvæ. From this cell I allowed a slip of paper to hang down to within $\frac{3}{10}$ of an inch of the upper surface of the artificial nest (N). At one side I put another block of wood (C) with a lateral projection (D) which hung over the cell containing the larvæ. I then made a connexion between D and A, so that ants could ascend C, and, passing over D, descend upon the larvæ. I then put some specimens of *Lasius niger* to the larvæ, and soon a large number of ants were engaged in carrying off the larvæ. When this had continued for about three hours, I raised D $\frac{3}{10}$ of an inch above A. The ants kept on coming and tried hard to reach down from D to A, which was only just out of their reach. Two or three, in leaning over, lost their foothold and dropped into the larvæ; but this was obviously an accident; and after a while they all gave up their efforts and went away, losing their prize, in spite of most earnest efforts, because it did not occur to them to drop $\frac{3}{10}$ of an inch.

Fig. 1.

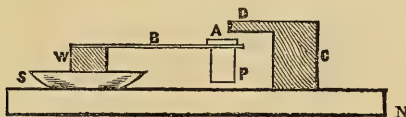


Diagram to illustrate experiments described in text.

At the moment when the separation was made there were fifteen ants on the larvæ. These could, of course, have returned if one had stood still and allowed the others to get on its back. This, however, did not occur to them; nor did they think of letting themselves drop from the bottom of the paper on to the nest. Two or three, indeed, fell down, I have no doubt, by accident; but the remainder wandered about, until at length most of them got into the water. After a time the others abandoned altogether as hopeless the attempt to get at the larvæ.

I waited about six hours, and then again placed the glass (A) containing the larvæ so as to touch the piece of wood (D), and again put some ants to the larvæ. Soon a regular string of ants was established; when I again raised the wood (D) $\frac{3}{10}$ of an inch above the glass (A), exactly the same result occurred. The ants bent over and made every effort to reach the larvæ, but did not drop themselves down, and after a while again abandoned all hope of getting the larvæ.

Experiments testing Intelligence.

In order to test their intelligence, it seemed to me that there was no better way than to ascertain some object which they would clearly desire, and then to interpose some obstacle which a little ingenuity would enable them to overcome. Following up, then, the preceding observations, I placed some larvæ in a cup which I put on a slip of glass surrounded by water, but accessible to the ants by one pathway in which was a bridge consisting of a strip of paper $\frac{2}{3}$ inch long and $\frac{1}{3}$ inch wide. Having then put a *Formica nigra* from one of my nests to these larvæ, she began carrying them off, and by degrees a number of friends came to help her. I then, when about twenty-five ants were so engaged, moved the little paper bridge slightly, so as to leave a chasm, just so wide that the ants could not reach across. They came and tried hard to do so; but it did not occur to them to push the paper bridge, though the distance was only about $\frac{1}{3}$ inch, and they might easily have done so. After trying for about a quarter of an hour, they gave up the attempt and returned home. This I repeated several times.

Then, thinking that paper was a substance to which they were not accustomed, I tried the same with a bit of straw 1 inch long and $\frac{1}{8}$ inch wide. The result was the same. I repeated this twice.

One day (Oct. 27th, 1876) I put some provisions in a shallow box with a glass top and a single hole on one side; I then put some specimens of *Lasius niger* to the food, and soon a stream of ants was at work busily carrying supplies off to the nest. When they had got to know the way thoroughly, and from thirty to forty were so occupied, I poured some fine mould in front of the hole so as to cover it up to a depth of about $\frac{1}{2}$ an inch. I then took out the ants which were actually in the box. As soon as the ants had recovered from the shock of this unexpected proceeding on my part, they began to run all round and about the box, looking for some other place of entrance. Finding none, however, they began digging down into the earth just over the hole, carrying off the grains of earth one by one and depositing them without any order all round at a distance of from $\frac{1}{2}$ to 6 inches, until they had excavated down to the doorway, when they again began carrying off the food as before.

This experiment I repeated on the following days three or four times, always with the same result.

I also tried the same experiment with another species, viz. *L. flavus*, and with the same result.

As to power of Communication.

In my previous paper I have recorded various experiments made with the view of ascertaining whether, when ants have found a store of food, they are able to describe the route to their companions. The following also seems to me instructive. I put an ant (*L. niger*) to some larvæ as usual, and when she knew her way, I allowed her to go home on her own legs; but as soon as she emerged from the nest, if she had any friends with her, I took her up and carried her to the larvæ. Under these circumstances very few ants indeed found their way to them. Thus, June 22, at 5.30, an ant which had been previously under observation was put to some larvæ. She took one and returned as usual to the nest. At 5.34 she came out with no less than 10 friends, and was then transferred to the larvæ. The others wandered about a little, but by degrees returned to the nest, not one of them finding their way to the larvæ. The single one above referred to picked up a larva, returned, and again came out of the nest at 5.39 with eight friends, when exactly the same thing happened. She again came out with companions at the under-mentioned times:—

Hour.	Number of friends.	Hour.	Number of friends.
5.44	4	6.44	—
5.47	4	6.46	3
5.49	—	6.49	2
5.52	—	6.56	—
5.54	5	6.59	—
5.57	2	7. 2	2
5.59	2	7. 4	—
6. 1	5	7. 6	3
6. 4	1	7. 8	3
6. 7	—	7.10	5
6.11	3	7.13	—
6.14	4	7.17	3
6.17	6	7.19	7
6.20	—	7.21	5
6.23	5	7.24	—
6.25	6	7.26	3
6.29	8	7.29	1
6.32	2	7.31	2
6.35	—	7.35	—
6.42	4		

Thus during these two hours more than 120 ants came out of the nest in company with the one under observation. She knew her way perfectly ; and it is clear that if they had been left alone, all these ants would have accompanied her to the store of larvæ. Three of them were accidentally allowed to do so ; but of the remainder, only five found their way to the larvæ ; all the others, after wandering about a while, returned hopelessly to the nest.

One of the ants which I employed in my experiments was under observation several days. I was, however, away from home most of the day, and when I left in the morning and went to bed at night I put her in a bottle ; but the moment she was let out she began to work again. On one occasion I was away for a week, and on my return I let her out of the bottle, placing her on a little heap of larvæ about 3 feet from the nest. Under these circumstances I certainly did not expect her to return. However, though she had thus been six days in confinement, the brave little creature immediately picked up a larva, carried it off to the nest, and, after half an hour's rest, returned for another.

Individual Influence or Character.

Another point of considerable interest is the difference in individual character or influence which seems to be indicated by some of the experiments.

For instance, on the 21st of June, at 6 minutes past noon, a worker of *F. nigra* was put to some larvæ; she carried off one as usual and returned as follows, viz. at

12. 6	12.19	12.30	12.47
12. 8	12.21	12.33	12.51
12.10	12.23	12.36	
12.15	12.26	12.40	
12.17	12.28	12.44	

During this time only two other ants came to the larvæ. We then imprisoned the ant and put another to the same larvæ at 2.56. This ant already knew her way well, and she returned as follows, viz. :—

2.58	3.11	3.25	3.52
3. 1	3.13	3.27	3.57
3. 4	3.15	3.30	
3. 6	3.20	3.34	
3. 9	3.22	3.36	

During this time no other ant came. We then imprisoned her again, and put a third ant to the same larvæ. She returned at

4.20	4.30	4.46	5. 6
4.23	4.36	4.56	5.10
4.26	4.40	5. 0	
4.28	4.42	5. 2	

when we left off watching her. Between 4.20 and 4.40 this ant brought 10 friends with her; but it is curious that from 4.40 to the end of the observation no more came. I have often observed that when an ant first begins to work, she brings many more friends than afterwards.

Intelligence and Affection.

As evidence both of their intelligence and of their affection for their friends, it has been said by various observers that when ants have been accidentally buried they have been very soon dug out and rescued by their companions. Without for one moment doubting the facts as stated, we must remember the habit which

ants have of burrowing in loose fresh soil, and especially their practice of digging out fresh galleries when their nests are disturbed.

It seemed to me, however, that it would not be difficult to test whether the excavations made by ants under the circumstances were the result of this general habit, or really due to a desire to extricate their friends.

With this view I tried the following experiments :—

(1) I placed (Aug. 20) some honey near a nest of *Lasius niger* on a glass surrounded with water, and so arranged that in reaching it the ants passed over another glass covered with a layer of sifted earth, about one third of an inch in thickness. I then put some ants to the honey, and by degrees a considerable number collected round it. Then at 1.30 P.M. I buried an ant from the same nest under the earth, and left her there till 5 P.M., when I uncovered her. She was none the worse, but during the whole time not one of her friends had taken the least notice of her.

(2) Sept. 1. I arranged some honey again in the same way. At 5 P.M. about 50 ants were at the honey, and a considerable number passing to and fro. I then buried an ant as before, taking of course one from the same nest. At 7 P.M. the number of ants at the honey had nearly doubled. At 10 P.M. they were still more numerous, and had carried off about two thirds of the honey. At 7 A.M. the next morning the honey was all gone, two or three were still wandering about, but no notice had been taken of the prisoner, whom I then let out. In this case I allowed the honey to be finished, because I thought it might perhaps be alleged that the excitement produced by such a treasure distracted their attention, or even (on the principle of doing the greatest good to the greatest number) that they were intelligently wise in securing a treasure of food before they rescued their comrade, who, though in confinement, was neither in pain nor danger. So far as the above ants, however, are concerned, this cannot, I think, be urged.

(3) On the 8th Sept. I repeated the experiment, burying some ants at 4 P.M. Up to 6.3 no attempt had been made to release them. I let them out and buried some more. The next morning, at 7 A.M., the honey was all gone, some ants were still wandering about, but no notice had been taken of the captives, whom I then liberated.

(4) I then (Aug. 21) made exactly the same experiment with *Myrmica ruginodis*, as representing the other great family of

ants. At 2.30 I buried one as before under about $\frac{1}{2}$ of an inch of fine earth. A great many of her friends were passing continually over her head, but not one of them took any notice of her till 7 P.M., when I let her out.

(5) About a month later, on Sept. 10, I again tried the same experiment, imprisoning some at 10.15 A.M. Up to 4.30 they had not been released. I then let them out, and buried some more. The next morning the honey was all consumed, but some of the ants were still searching about. The prisoners, however, were still in durance.

But even if their friends who are in difficulty are actually in sight, it by no means follows that their companions will assist them.

Of this I could give almost any number of cases. Thus on one occasion several specimens of *Formica fusca* belonging to one of my nests were feeding on some honey spread on a slip of glass (May 22). One of them had got thoroughly entangled in it. I took her and put her down just in front of another specimen belonging to the same nest, and close by placed a drop of honey. The ant devoted herself to the honey and entirely neglected her friend, whom she left to perish.

Again, some specimens of *Cremastogaster scutellaris* were feeding quietly (May 22) on some honey spread on a slip of glass, and one of them had got thoroughly mixed in it. I took her out and put her on the glass close by. She could not disentangle herself; not one of her friends took the least notice of her, and eventually she died. I then chloroformed one and put her on the board among her friends. Several touched her, but from 12 to 2.30 P.M. none took any particular notice of her*.

I thought, however, that it would be desirable to make some systematic observations on the subject. The results were as follows.

Sept. 10, at 6 P.M., a number of *Lasius flavus* from one of my captive nests were out feeding on some honey. I chloroformed four of them and also four from a nest in the park, at some distance from the place where the first had been originally procured, and put them close to the honey. Up to 8.20 the ants had taken no notice of their insensible fellow creatures. At 9.20 I found that

* Dead ants, I may add, are always brought out of the nest, and I have more than once found a little heap on one spot, giving it almost the appearance of a burial-ground.

four friends were still lying as before, while the four strangers had been removed. Two of them I found had been thrown over the edge of the board on which the honey was placed. The other two I could not see.

Again, on the 14th Sept., at 8.40, I put in the same way four friends marked white, and four strangers marked red, close to where my *L. flavus* were out feeding on honey placed on a slip of glass over water. For some hours they took no notice of them. At length one took a friend, and after carrying her about some time, at 12.40, dropped her into the water. Some time after another took up a stranger and carried her into the nest at 2.35. A second stranger was similarly carried into the nest at 2.55, a third at 3.45, while the fourth was thrown over the edge of the board at 4.20. Shortly after this two of the strangers were brought out of the nest again and thrown away. A second friend was thrown away, like the first, at 4.58, the third at 5.17, and the fourth at 5.46. I could not ascertain what happened to the last stranger, but have little doubt that she was brought out of the nest and thrown away like the rest.

On the following day at 6.45 I tried the same experiment again, only marking the friends red and the strangers white. At 7 one of the strangers was carried off and dropped over the edge of the glass into the water, and at 8 a second. At 8.45 a friend was taken up and, after being carried about some time, was thrown into the moat. At 9.45 a friend was picked up and carried into the nest, but brought out again and thrown away about 3 in the afternoon. The other four remained where they were placed until 8 P.M., and though the other ants often came up and examined them, they did not carry them off.

Sept. 29. Again placed nine chloroformed ants, five friends and four strangers, close to where a number were feeding. There was a continual stream of ants to the honey, ten or fifteen being generally there at once.

A stranger was picked up at 10.20 and dropped at 10.32

"	"	"	10.22	"	10.35
A friend	"	"	11.22	"	11.42
A stranger	"	"	11.35	"	11.50
"	"	"	11.41	"	11.45

Shortly after the others were picked up and carried away to the edge of the board, where they were dropped, but none were taken into the nest.

Oct. 2. Again at 10 A.M. placed ten chloroformed ants, five friends and five strangers, close to where some were feeding. They were picked up and carried off as before in the following order:—

At 11. 5	a stranger	was picked up and dropped	at 11.15
11.12	a friend	”	11.50
11.25	a stranger	”	11.36
12. 7	”	”	12.45
12.10	a friend	”	12.16
1.10	a stranger	”	2. 6
1.42	a friend	”	1.46
1.52	”	”	1.56
2. 6	”	”	3.10

Only one of them, and that one a stranger, was carried into the nest at 12.45, but brought out again at 1.10.

Oct. 6. At 9 A.M. again tried the same experiment with four strangers and five friends.

At 9.25	a friend	was picked up and dropped	at 9.31
9.32	”	”	9.38
9.35	a stranger	”	9.45
9.45	a friend	”	9.52
10. 8	a stranger	”	10.17
10.17	a friend	”	10.20
10.22	a stranger	”	10.25
10.28	”	”	10.40
10.25	a friend	”	10.31

None of them were carried into the nest.

These experiments seem to prove that under such circumstances ants, at least those belonging to this species, do not carry their friends (when thus rendered insensible) off into a place of safety.

It may, however, be said that in this experiment, the ants being to all intents and purposes dead, we could not expect that any difference would be made between friends and strangers. I therefore repeated the same experiment, only instead of chloroforming the ants I intoxicated them. This experiment is more difficult, as it is not in all cases easy to hit off the requisite degree of intoxication. The numbers therefore of friends and strangers are not quite the same, because in some cases the ants recovered too quickly and had to be removed. In such cases I have latterly replaced the ant so removed by another, so as to keep the number of friends and strangers about equal. I must make more obser-

ventions; but so far as they have gone they are as follows. The sober ants seemed somewhat puzzled at finding their intoxicated fellow creatures in such a condition, took them up, and carried them about for a time in a somewhat aimless manner.

Nov. 20. I experimented with six friends and six strangers, beginning at 11.

At 11.30 a friend was carried to the nest.

11.50 a stranger was dropped into the water.

12.30 " " "

12.31 a friend " "

1.10 a stranger " "

1.18 " " "

1.27 " " "

1.30 a friend (partly recovered) was taken to the nest.

2.30 " was taken up and carried about till 2.55; she was then taken to the nest, but at the door the bearer met two other ants, which seized the intoxicated one, carried her off, and eventually dropped her into the water.

At 3.35 a friend was carried to the nest.

Out of these 12, 5 strangers and 2 friends were dropped into the water; no stranger but 3 friends were taken to the nest. None of the friends were brought out of the nest again.

Nov. 22. Experimented in the same way on four friends and four strangers, beginning at 12.

At 12.16 a stranger was taken and dropped into the water.

12.21 " " "

12.23 " " "

12.40 " " "

I then put 4 more strangers.

3.10 a stranger was taken and dropped as before.

3.30 " " "

3.35 " " "

3.44 a friend (partly recovered) was taken back to the nest.

4.10 a stranger was taken and dropped into the water.

4.13 a friend (partly recovered) was taken back to the nest.

In this case 8 strangers were dropped into the water, and none were taken to the nest; 2 friends, on the contrary, were taken to the nest, and none were dropped into the water.

Dec. 1. Experimented with five friends and five strangers, beginning at 2.15.

At 2.30 a stranger was dropped into the water.

3. 2 " " "

At 3.20 a friend was taken into the nest.

- 3.35 a stranger " "
- 3.52 " " "
- 4. 5 I put out four more friends and as many strangers.
- 4.45 a stranger was dropped into the water.
- 5.10 " taken into the nest.
- 5.24 " " "
- 5.55 a friend was thrown into the water.
- 6. 4 a stranger " "
- 6. 4 " " "
- 6. 8 a friend was taken into the nest.
- 6.20 " " "
- 6.23 " " "
- 6.30 a stranger was dropped into the water.
- 6.50 a friend " " "
- 8. 5 a friend was taken into the nest.

In this case 2 friends were thrown into the water and 7 taken into the nest; while 6 strangers were thrown into the water and 3 were taken into the nest (*all of these, however, were afterwards brought out again and thrown away*).

Dec. 8. Experimented with six friends and six strangers, beginning at 11.30.

At 11.30 a friend was carried to nest.

- 11.47 " "
- 11.50 " "
- 11.52 " "
- 11.56 a friend was dropped into water.
- 11.58 a stranger " "
- 11.58 " " "
- 12 a stranger was carried to nest.
- 12. 2 " " "
- 12. 3 " " "

I then put four more of each, replacing her by another as each was carried off.

At 12.42 a friend to water.	At 2.42 a stranger to water.
12.58 a stranger to water.	2.48 " "
1 a friend to nest.	2.51 " "
1 " "	2.52 " "
1 " "	2.55 a friend to nest.
1.58 " "	2.55 a stranger to water.
1.59 " "	2.55 " "
2.30 a stranger to water.	3. 2 a friend to water.
2.30 " "	3. 6 a stranger to water.
2.35 a stranger to nest.	3.12 a friend to water.

At 3.15 a friend to water.	At 3.25 a friend to nest.
3.16 a friend to nest.	3.35 a stranger to water.
3.22 a stranger to water.	3.50 a friend to nest.
3.25 " "	3.50 " "

All these ants appeared quite insensible ; 16 friends were then taken to the nest and 5 to the water, while of the strangers only 3 were taken to the nest, while 15 were thrown into the water. Moreover, as in the preceding observation, even the three strangers which were at first taken to the nest were soon brought out again and thrown away ; while this was not the case with any of the friends as far as we could ascertain, though we searched diligently for them also. In this case also all the intoxicated ants were motionless and apparently insensible.

Jan. 15. Repeated the same experiment, beginning at 12.20. Up to 7 P.M. not one of the intoxicated ants had been moved. At 8.20 we found a stranger in the water, at 9.30 another, and at the following morning a third. The others were untouched.

Jan. 17. Repeated the same experiment, beginning at 11.30.

At 12 a friend was carried to the nest.

12.20 a stranger was carried to the water.

12.34 a friend was carried to the nest.

12.40 a stranger was carried to the water.

12.45 a friend was carried to the nest.

1 a stranger " "

1 " " " " water.

(Stopped observing till 2.)

2.30 a stranger was carried to the water.

2.30 " " " nest.

4.10 " " "

4.30 a friend " "

6.20 a stranger was carried to the water.

6.35 " " "

Thus, then, the general results were that the ants removed thirty-eight friends and forty strangers. Of the friends, twenty-seven were carried into the nest and seven were thrown into the water. Of the strangers, on the contrary, thirty were thrown into the water ; only nine were taken into the nest, and seven of these were shortly afterwards brought out again and thrown away. Indeed I fully believe that the other two were treated in the same manner, though we could not satisfy ourselves of the fact. But it was only by very close observation that the seven were detected, and the other two may well have escaped observation.

*Tabular View.—Experiments on Ants under Chloroform
and Intoxicated.*

Chloroformed Ants.

Friends.				Strangers.		
	To nest.	To water.	Unre- moved.	To nest.	To water.	Un- removed.
Sept. 10...	.....	...	4	.....	4	
„ 14...	.....	4	...	2	2	
„ 15...	1 and brought out again.	1	...	and brought out again.	2	2
„ 29...	.....	5	...	.....	4	
Oct. 2...	.....	5	...	1	4	
„ 6...	.....	5	...	and brought out again.	4	
	1	20	4	3	20	2

Intoxicated Ants.

Nov. 20...	3	2	...	.....	5	1
„ 22...	2	...	2	.....	8	
Dec. 1...	7 none brought out again.	2	...	3 all these brought out again.	6	
„ 8...	16 none brought out again.	5	...	3 all these brought out again.	15	
Jan. 15...	...	...	4	.....	3	1
„ 17...	4 none brought out again.	...	...	3 one brought out again.	6	
	27	7	4	9	30	1

In these cases some of the Ants had partly recovered ; in the following they were quite insensible.

Recollection of Friends.

In my previous paper* I recorded some facts tending to show not only that ants belonging to the same nest know one another, but also that they recollect one another after being separated for some months.

This was made evident by separating a colony into halves, registered as Nests No. 4 and 5, and then from time to time introducing an ant from one division into the other. As the nests under observation consisted of a thin stratum of earth between two glass plates, I was able to see exactly how the ant thus introduced behaved herself, and how she was treated by the others.

One of the colonies thus separated belonged to *Formica fusca*, and was divided on the 4th Aug., 1875. The observations made in the same year have been already recorded. On the 15th March following, I put in a stranger and one of the old companions from the other half of the nest at 7 A.M., and watched them longer than those previously experimented on. The stranger was very soon attacked; the friend seemed quite at home.

4th June. 8 A.M. Put into the nest a stranger and an old friend. The stranger was at once attacked, and dragged about by one of her antennæ. 9 A.M. The stranger was being attacked; the friend, though not attacked, kept rather away from the other ants. 10.30 A.M. The stranger was attacked, not the friend. 12.30 P.M. do., 1 P.M. do., 1.30 P.M. do., 2 P.M. do., 2.30 P.M. do. 4 P.M. do., 4.30 P.M. do. 5 P.M. The stranger was dead.

5th June. Put in a stranger and a friend at 9.30. At 10 the stranger was being attacked, not the friend. 10 A.M. do., 10.30 A.M. do.

At 11 I put in another stranger and another old friend, when nearly the same thing was repeated. At 11.30 A.M. the stranger was being dragged about by an antenna; the friend was not attacked. 12. The stranger was by herself in a corner of the nest. The friend was almost cleaned from the paint by which she was marked. I therefore put in another friend. At 2 the stranger was being dragged about by an antenna, the friend was being cleaned. 2.30 do., 3 do. At 3.30 the friend was almost clean; the stranger is being dragged about. 6 do.

10th June. Repeated the same observation at 10 A.M., but transposed the colours by which they were distinguished, so that

* See vol. xii. p. 494, lines 17 and 18 from the top, and under the head of Nov. 7, I unfortunately transposed the words "former" and "latter."

there might be no question whether perhaps the difference of treatment was due to the difference of colouring. At 11 A.M. the friend was all right, the stranger was being dragged about by an antenna. 11.30 A.M. the friend all right, the stranger being dragged about by one leg. 12 do. 12.30 P.M. the friend all right, the stranger being dragged about by an antenna. 1 P.M. do., 2 P.M. do., 3 P.M. do.

3rd July. Put in a friend and a stranger at 11 A.M. At 11.30 A.M. the stranger was being dragged about, the friend was being cleaned. 12 do. 12.30 A.M. both were now being attacked. 1 do.

This seems to show that some, at least, of the ants have forgotten their old friends.

16th July. Put in two friends at 7.45 A.M. At 8 A.M. each was being dragged about by an antenna. 8.30 A.M. one was being dragged about by both antennæ, the other by both antennæ and one leg. 10 A.M. both were still attacked, but it is curious that at the same time others were cleaning off the paint. 12.30, both still attacked.

17th July. Put in a friend at 8.15 A.M. At 8.30 they were cleaning her. At 9 A.M. she was almost clean. 9.30 she seemed quite at home, and had only one spot of paint on her. 10.20 do.

20th July. Put in a friend and stranger at 9 A.M. At 9.30 A.M. the friend seemed all right; the stranger was in a corner by herself. At 10 A.M. the friend was being cleaned; the stranger had come out of her corner and was being fiercely attacked. At 11 A.M. the friend seemed quite at home and was almost cleaned; the stranger was being dragged about, but was almost cleaned. At 12 the same thing was going on, and also at 12.30. At 1.30 the stranger was still being pulled about; but what struck me as remarkable, the friend also had hold of one of the ants by an antenna. At 2 P.M. the friend was by herself, the stranger was being attacked. At 4 P.M. the friend again had hold of an ant by an antenna; the stranger was being pulled about. At 5 the friend seemed quite at home in the nest; the stranger was killed. The following morning I was still able to distinguish the friend; she seemed quite at home.

6th Aug. Put in a stranger and a friend at 8 A.M. At 8.30 both were attacked. 9 do., 9.30 do., 10 do., 11 do., 12.30 do.

6th Aug. Repeated the experiment at 2. Both ants hid themselves in corners. At 3.30 the stranger was being attacked; the friend was in a corner by herself. At 4.30 both were attacked. 5.30 do.

7th Aug. Put in a stranger and a friend at 8.30 A.M. At 8.45 both were being attacked. 9.30 do., 10 do.

Aug. 8. Put in a friend at 7 A.M. At 8 she seemed quite at home with the others. At 9 they had almost cleaned her. 9.30 she seemed quite at home with the others. 10 do.

12th Aug. Put in a friend and a stranger at 7 P.M. Both were immediately attacked. 7.15 they were being dragged about. 7.45 do, 8 do., 8.15 do.

13th Aug. Put in a friend at 6.30 A.M. At 7.50 two attacked her. At 8 she was being attacked by one ant, but another was cleaning her. 8.15 do. 8.45. Two were attacking her, one dragging at her by an antenna. 9 do., 9.30 do., 10 do., 10.30 do. Others had almost entirely cleaned off the paint.

At 5 P.M. put a friend and a stranger into the other nest. At 5.15 the friend seemed quite at home, and had been nearly cleaned; the stranger was being attacked. 5.30 do., 8.15 do. 7.15. Two of the ants were dragging the stranger out of the nest; the friend had been quite cleaned.

14th Aug. At 8.15 A.M. I put an ant from each half of the nest into the other. At 8.30 one was alone in the corner, the other was being attacked. At 9 both were being attacked. 9.30 do., 10.30 do.; 11.30 do., both, however, being almost cleaned.

Aug. 19. At 8 A.M. I put into each nest one from the other. The one was received amicably and cleaned, so that I lost sight of her. It was clear, however, that she was received in a friendly manner, because no fighting was going on. At 11 I put into the same nest another friend: at 11.30 she was all right, and, being cleaned at 12, I could no longer distinguish her.

The ant put into the other nest was not so well received. At 9.30, 12.30, and 11.30 she was being dragged about, but she was also being cleaned, and after 11.30 I lost sight of her.

Aug. 21. At 10.15 I again put into each nest an ant from the other. One was at once cleaned, and I could not find her. I should, however, certainly have seen her if she had been attacked.

The other was at first attacked by one of the ants; but this soon ceased, and they began to clean her. By 11.30 she was quite at her ease among the other ants and almost clean. After 12 I could not see her any more. At 1.40 P.M. I again put into each nest an ant from the other, accompanied, however, in both cases by a stranger. The contrast was most marked, and no one who saw it could have doubted that the friends and strangers were re-

spectively recognized as such, or that they themselves were fully aware of their position.

In the first nest the friend at once joined the other ants, who began to clean her. The stranger ran about in evident alarm, was pursued by the others, and took refuge in a corner. At 2 the friend was with the other ants, the stranger alone in a corner. At 2.25 the friend was almost cleaned, and after 2.30 we could no longer distinguish her: the stranger was still alone. At 3.40 she came out of her hiding-place and was attacked; after a while she escaped from the nest. At 5.30 she met one of the ants, and a battle at once began. I separated the combatants and put the stranger back near her own nest, which she at once entered, and where she was soon cleaned by her own friends.

I will now describe the adventures of the other couple. The friend immediately joined the other ants; the stranger was hunted about and soon seized. At 2 the friend was all right, the stranger being dragged about. At 2.30 ditto. The stranger was soon killed. The friend, whom I watched at intervals till 6.30, continued on the best terms with the others; it was quite clear, therefore, that they did not regard her as a stranger. She herself was not afraid of, and did not avoid them. Still for some time she apparently wished to return home. She came out of the nest and tried to find her way home to her own nest. I put her back again, however, and by the evening she seemed to have accustomed herself to the change. I opened the door of the nest soon after 5; but she showed no wish to leave her newly acquired friends.

Sept. 1. At 11 A.M. I again put into each nest an ant from the other and a stranger. In the one nest the friend joined the other ants, and seemed quite at home; the stranger, on the contrary, endeavoured to conceal herself, and at length, at 4 in the afternoon, escaped from the nest.

In the other division the friend also appeared quite at home. The stranger, on the contrary, endeavoured to escape, but in the course of the afternoon was attacked and killed.

Oct. 15. At 8 A.M. I repeated the same experiment. In the first nest, up to 10 A.M., neither ant was attacked; and it is curious that the stranger was licked and, indeed, almost cleaned. Soon afterwards, however, the ants began to attack her, and at 3 P.M. she was dead, the friend, on the contrary, being quite at home. Still the following day at midday I found her out of the nest (all the rest being within). This almost looks as if, though safe, she

did not feel at home; and I accordingly put her back to the other nest, which she at once entered.

In the other division the friend was soon nearly cleaned, and the stranger partly so. The friend seemed quite at home. At 12.30 the stranger was being dragged about by three ants; but after this I lost sight of her.

Nov. 10. At 11.30 put into one of the divisions a friend and a stranger. At 12 the friend was all right, the stranger was being dragged about by an antenna. From this time till 7 P.M. the stranger was continually being dragged about or held a prisoner, while the friend was quite at home.

Nov. 11. At 10.15 I put into the other division a friend and a stranger. At 11 the friend was quite at home, and the colour with which I had marked her had been almost cleaned off. The stranger, on the contrary, was being dragged about by two of the ants. After this, however, I could not find her. She had, I think, escaped from the nest.

Nov. 12. I therefore, the following day at 11.30, again put a friend and a stranger into this division of the nest. The friend seemed quite at home. One of the ants at once seized the stranger by an antenna and began dragging her about. I will give this observation in detail out of my note-book.

At 11.45. The friend is quite at home with the rest; the stranger is being dragged about.

At 12. The friend is all right. Three ants now have hold of the stranger by her legs and an antenna.

At 12.15, 12.30, 12.45, and at 1 similarly occupied.

At 1.30 similarly engaged. One now took hold of the friend, but soon seemed to find out her mistake and left go again.

At 1.45. The friend is all right. The stranger is being attacked. The friend also has been almost cleaned, while on the stranger the colour has been scarcely touched.

At 2.15. Two ants are licking the friend, while another pair are holding the stranger by her legs.

At 2.30. The friend is now almost clean; so that I could only just perceive any colour. The stranger, on the contrary, is almost as much coloured as ever. She is now near the door and, I think, would have come out, but two ants met her and seized her.

At 3. Two ants are attacking the stranger. The friend was no longer distinguishable from the rest.

At 3.30, 3.40, and 5 engaged as above.

At 6.0. The stranger now escaped from the nest, and I put her back among her own friends.

The difference of behaviour to these two ants was therefore most marked.

The friend was gradually licked clean, and except for a few moments, and that evidently by mistake, never attacked. The stranger, on the contrary, was not cleaned, was at once seized, was dragged about for hours with only a few minutes' interval, by one, two, or three assailants, and at length made her escape from the nest at the time when no other ant was out.

Dec. 11. At 10 A.M. I again put in a friend and a stranger. The friend was not attacked, and consorted peaceably with the rest. I found her again all right on the following morning. The stranger, on the contrary, was soon attacked and killed.

Dec. 22. Repeated the same experiment. The stranger was attacked and driven out of the nest. The friend was received quite amicably.

Dec. 26. Ditto. The friend was received as usual. I lost sight of the stranger, who probably escaped.

Dec. 31. Ditto. In this case the stranger, after being dragged about some time in the nest, made her escape. But even outside, having met with an ant accidentally, she was viciously attacked.

Jan. 15. Ditto.

Jan. 16. I put in two friends; but thinking the preceding experiments sufficient, I did not on this occasion add a stranger. Neither of the friends was attacked.

Jan. 19. Put in two friends at 11 A.M. Neither was attacked, and the following morning they were all right amongst the rest.

Jan. 22. Put in three friends, with the same result.

Jan. 24. " two " "

Jan. 26*. " three " "

These details are, I fear, tedious, but they may be worth giving, because a mere statement of the general facts without particulars would not convey so clear an idea of the result. The following table shows it in a condensed form:—

* Since this paper was read, I have continued these observations, viz.:— On Feb. 11 put in two friends, on Feb. 12 three, on Feb. 13, 15, and 19, and on March 11 and 12, one friend, on March 18 two, on April 21 one, and on April 22 and 23 two friends; but in none of these instances were the friends attacked

Experiments with Ants of different Nests.

Separation of Nest, Aug. 4, 1875.

*F. fusca.**Myrmica ruginodis.*

	<i>F. fusca.</i>		<i>Myrmica ruginodis.</i>	
	Friend.	Enemy.	Friend.	Stranger.
8 Aug. ...	.....	Attacked.		
13 " ...	.....	"	
16 " ...	Not attacked.			
20 " ...	.....	Attacked.		
22 " ...	Not attacked.	"		
3 Sept. ...	"	Not attacked.	} Not much watched.	
17 " ...	"	"		
3 Oct. ...	"	"		
15 Mar. ...	"	Attacked.	3 Oct.	Not attacked. Attacked.
4 June ...	"	Killed.	18 "	" Killed.
5 " ...	"	Attacked.	19 "	" "
5 " ...	"	"	20 "	" "
10 " ...	"	Attacked and killed.	24 "	" "
3 July ...	Attacked.	Attacked.	31 "	" "
10 " ...	"	.....	7 Nov.	" "
16 " ...	"			
16 " ...	"			
17 " ...	Not attacked.			
17 " ...	"			
20 " ...	"	Attacked and killed.		
6 Aug. ...	Attacked.	Attacked.		
6 " ...	"	"		
7 " ...	"	"		
8 " ...	Not attacked.			
12 " ...	Attacked.	"		
13 " ...	"			
13 " ...	Not attacked.	"		
14 " ...	Attacked?			
14 " ...	" ?			
19 " ...	"			
21 " ..	Not attacked.			
21 " ...	"			
21 " ...	"			
21 " ..	"	Attacked and killed.		
1 Sept. ...	Not attacked.	Ran away.		
1 " ...	"	Attacked.		

		<i>F. fusca.</i>	
		Friend.	Enemy.
15 Oct. ...	Not attacked.		,,
15 " ...	"		"
10 Nov. ...	"		"
11 " ...	"		"
12 " ...	"		"
11 Dec. ...	"		"
22 " ...	"	Escaped from the nest.	
26 " ...	"	Not attacked.	
31 " ...	"	Attacked.	

Some further observations on *F. fusca*, viz. on January 15th, when a stranger was attacked, whereas twice on the 16th, twice on the 19th, thrice on the 22nd, twice on the 24th, and thrice on the 26th of the same month, all resulted in a friend not being attacked*.

I must, however, point out one thing which must be taken into consideration. As I sometimes transposed ants from one division of the nest to the other, it might be said that some of the friends were among those which had been brought more recently from the other half of the nest.

Of the ants thus transposed, there were, however, altogether, in nest No. 5, only thirteen, in nest No. 4 twenty-three, some of which, moreover, must certainly have been among those that died. After the beginning of November all the transfers were made from No. 4 into No. 5. Since December last thirty-one ants have been so transferred; even assuming then that I had unluckily hit upon all the transferred ants (which is of course little short of an impossibility), eight of them, at any rate, had not been in nest No. 5 since August 1875.

Thus, then, for more than a year these ants remembered their old companions, as is shown by the fact that they received them amiably while they attacked strangers. It is surprising that the ants of a nest should all know one another; but that this should be still the case after more than a year's separation seems to me not the least marvellous point connected with them.

* The following cases have been added since the reading of this paper:—Feb. 11 two friends, Feb. 12 three, Feb. 13, 15, and 19, and March 11 and 12, one friend, March 18 two friends, April 21 one, and April 22 and 23 two friends, none of which when introduced were attacked.

Contrast in Behaviour of different kinds of Ants.

The behaviour of *Lasius flavus* offers a surprising contrast to that of *F. fusca*. I was anxious to see whether the colonies of this species, which are very numerous round my house, were in friendly relations with one another. With this view, I kept a nest of *L. flavus* for a day or two without food and then gave them some honey, to which they soon found their way in numbers. I then put in the midst of them an ant of the same species from a neighbouring nest; the others did not attack, but, on the contrary, cleaned her—though, from the attention she excited and the numerous communications which took place between her and them, I am satisfied that they knew she was not one of themselves. After a few minutes she accompanied some of the returning ants to the nest. They did not drag nor apparently guide her; but she went with them quite freely. This I repeated several times with the same result.

I then took four ants, two from a nest about 500 yards from the first in one direction, the other from an equal distance in another. In all cases the result was the same. I then got a few from a colony about half a mile off. These also were most amicably received, and in every case the stranger went of her own accord to the nest. One of the strangers was, indeed, dragged about half way to the entrance of the nest, but was then left free and might have run away if she had liked. She, however, after wandering about for about half a minute, voluntarily entered the nest. In one or two cases the stranger ran as quickly and straight to the nest as if she had been there over and over again. This, I suppose, can only have been by scent; and certainly no hounds in full cry could have pursued their game more directly or with less hesitation. In other cases, however, they were much longer before they went in. To satisfy myself that these facts were not owing to the nest having been taken from that of colonies or allies, I subsequently procured some ants of the same species from a nest in Hertfordshire; and they also behaved in a similar manner. In one or two cases they seemed to be attacked, though so feebly that I could not feel sure about it; but in no case were the ants killed.

The following fact surprised me still more. I put an ant (Aug. 31) at 9 A.M. on a spot where a number of *F. flava* (belonging to one of my nests of domesticated ants) had been feeding some hours previously, though none were there, or, indeed, out at all, at the

moment. The entrance to the nest was about 8 inches off; but she walked straight to it and into the nest. A second wandered about for four or five minutes and then went in; a third, on the contrary, took a wrong direction, and, at any rate for three quarters of an hour, did not find the entrance.

Very different is the behaviour of *L. niger* under similar circumstances. I tried the same experiment with them. There were no communications with the antennæ, there was no cleaning; but every ant which the stranger approached flew at her like a little tigress. I tried this experiment four times; each stranger was killed and borne off to the nest.

Suspected Cannibalism.

Ants have even been suspected of cannibalism by some writers *, because those which are found dead are generally more or less shrivelled, and the large females even are reduced almost to an empty shell. Huber's statement that their affection for their queens induces them to brush and lick them for days after death, has even been regarded as evidence of cannibalism rather than of affection. On this point, however, further evidence is required.

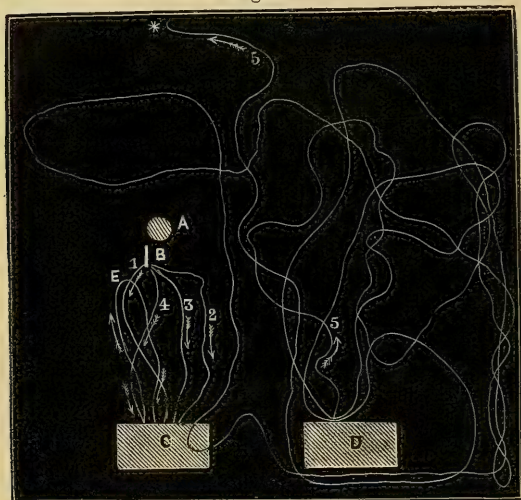
Experiments Testing the Senses. Sight.

In order to test how far they are guided by sight, I made various observations and experiments, the accompanying woodcuts being reduced copies of tracings of some of the tracks made by the ants during the course of the observations. I shall commence with experiment No. 2.

Exp. 2.—Feb. On the parade-ground (see fig. 2) I placed upright a common cylindrical lead-pencil $\frac{1}{4}$ inch in diameter and 7 inches long, fastened with sealing-wax to a penny-piece. Close to the base of the pencil (A) I brought the end of a paper bridge (B) leading to the nest, and then placed a shallow glass with larvæ at C, 4 inches from the base of the pencil. I then put an ant to the larvæ; when she had become acquainted with the road, she went very straight, as is shown in the woodcut (fig. 2). In one case, at the point E, she dropped her larva and returned for another. When she returned on the next journey and was on the glass, I moved it 3 inches, to D, so that the end of the glass was 6 inches from the base of the pencil. If she were much guided by sight, then she would have little or no difficulty in finding her way

* See, for instance, an interesting communication by Mr. Elwin, *Sci. Gossip*, Nov. 1870, p. 243.

Fig. 2.



Routes followed in experiment No. 2, as detailed above.

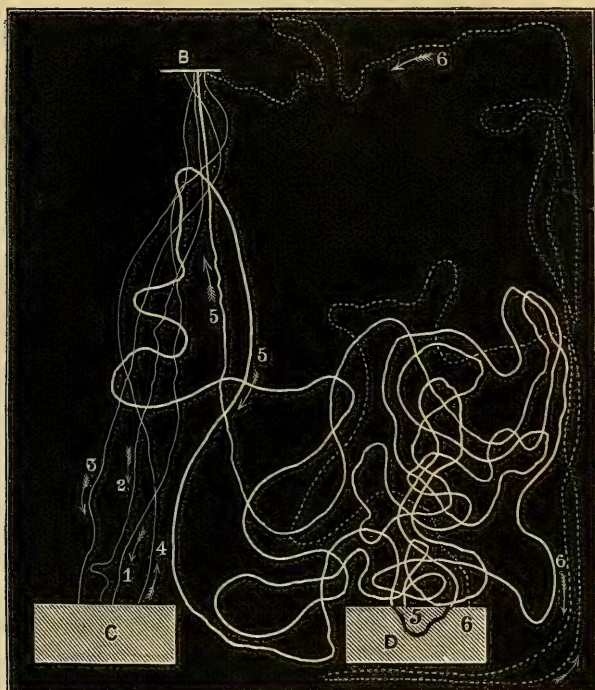
A, position of pencil. B, paper bridge. C and D, glass with larvæ. E, point where larva dropped, the opposite arrow and loop marking return route. 1, 2, 3, 4, comparatively straight paths to the glass. 5, 5, circuitous route on shifting of glass. * different access to nest.

back. Her pathway, however, which is traced on the paper, shows that she was completely abroad; and, after all, she got back to the nest by a different route (5).

I then varied the experiment as subjoined, and as shown in the woodcut (fig. 3).

Exp. 3.—I connected the parade-ground with the nest by a paper bridge, the end of which is shown at B (fig. 3), and which came down about an inch from the pole supporting the nest. This pole rises 18 inches above the parade-ground. I then put the glass tray (C) with larvæ as before, 12 inches from the base of the pole, and put an ant to the larvæ. When she had learnt her way I traced four of her routes, as shown in the thin lines 1, 2, 3, 4. I then on her next journey (5, thick white line), when she was on the tray (C), moved it three inches to D, as shown in the figure, and again traced her routes. The contrast is very striking between the relatively straight thin white lines 1, 2, 3, 4 of the four journeys when familiar with the road; whereas in the broad white line No. 5 the zigzag twistings show how much difficulty the ant

Fig. 3.



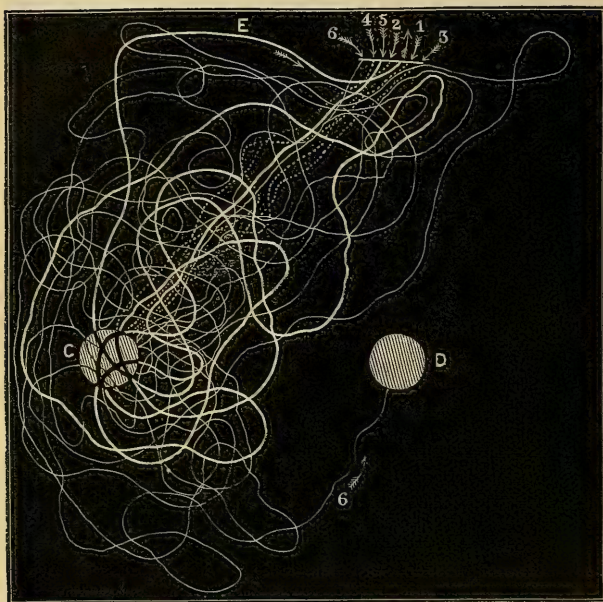
Routes followed in experiment No. 3, as mentioned in text.

B, paper bridge. C, glass tray with larvæ, its first position; and D its position when shifted. 1, 2, 3, 4, thin white lines indicating the comparatively straight routes. 5, thick white line, and 6, dotted line showing tortuous paths when glass had been altered in position. The arrows indicate directions travelled.

experienced in finding her way. Again the dotted sinuous white line (6) shows the course adopted on a subsequent journey.

Exp. 4.—I then again varied the experiment as follows:—I placed the larvæ in a small china cup on the top of the pencil, which thus formed a column $7\frac{1}{2}$ inches high. The cross line close to the arrows (fig. 4) is as before, the base of the paper bridge going to the nest. C shows the position of the penny on which the pencil is supported. The dotted white lines 1, 2, 3, 4 show the routes of a marked ant on four successive journeys from the nest to the base of the pencil. I then moved the pencil 6 inches to D, and the two following routes are marked 5 and 6. In one of them, 5 (thick white line), the ant found a stray

Fig. 4.



Routes followed in experiment No. 4, as described in text.

Cross line at the six arrows represents paper bridge going to nest. C, china cup on top of pencil. D, pencil moved. E, where stray larvæ were found. 1, 2, 3, 4, dotted lines show the nearly direct journeys. 5, thick white line (crossing C in black) of route returning to nest E, being position of larva in the course. 6, very circuitous thin white line of track from nest to pencil D.

larva at E, with which she returned to the nest, without finding the pencil at all. On the following journey, shown in fine white zigzag line (6), she found the pencil at last, but, as will be seen, only after many meanderings.

Exp. 5.—I then repeated the observation on three other ants (see figs. 5–7) with the same result: the second was 7 minutes before she found the pencil, and at last seemed to do so accidentally; the third actually wandered about for no less than half an hour, returning up the paper bridge several times.

Other experiments somewhat similar to the preceding, the results of which are shown in the figures 6 and 7, seem to prove that this species of ant, at any rate, guides itself but little by sight. This, which I had not at all anticipated, seems to follow from the fact that after the pencil and tray of larvæ had been

Fig. 5.

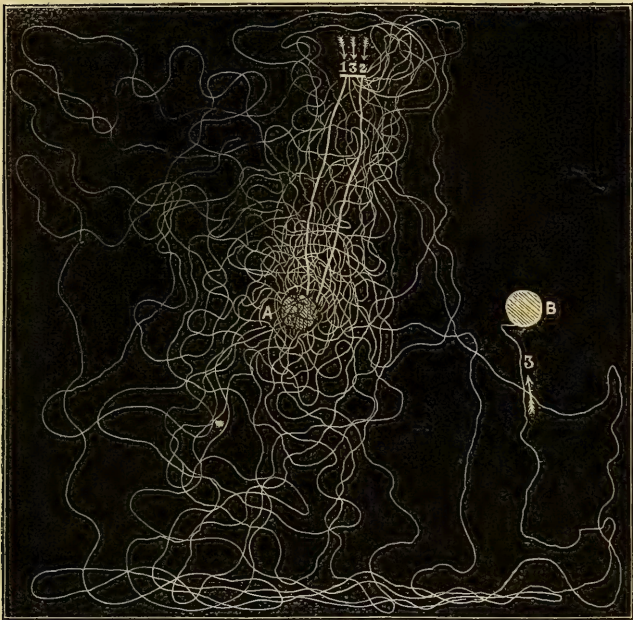


Diagram of complex path traversed in experiment 5.

A, first position of pencil. B, second position of pencil. 1, 2, straight lines of two tracks of the observed ant. 3, winding narrow white line, showing course pursued by the same ant before arriving at B, when the position of the pencil was unchanged.

removed but a short distance to the right or left, the ants on their journey to the shifted object travelled very often backwards and forwards and around the spot where the coveted object first stood. Then they would retrace their steps towards the nest, wander hither and thither from side to side between the nest and the point A, and only after very repeated efforts around the original site of the larvæ reach, as it were, accidentally the object desired at B.

Another evidence of this consists in the fact that if when *L. niger* were carrying off larvæ placed in a cup on a piece of board, I turned the board round so that the side which had been turned towards the nest was away from it, and *vice versa*, the ants always returned over the same track on the board, and, in consequence, directly away from home.

If I moved the board to the other side of my artificial nest, the

Fig. 6.



Diagram representing three tracks of an ant in another experiment.

A, the first position of pencil and the food, towards which and from the base-line of nest 1 and 2 lead by nearly direct broadish white lines to A. When the latter was removed to B the ant, in its effort to reach this, pursued the narrow white winding line ending in 3 →

result was the same. Evidently they followed the road, not the direction.

I may here note that the diagrams figs. 2-7 are careful reductions of large tracings made during the experiments. Though not absolutely correct in every minute detail of contour, they are exact for all practical purposes. As the ants pursued their way, pencil-markings in certain instances, and coloured lines in others, were made so as to follow consecutively the paths pursued.

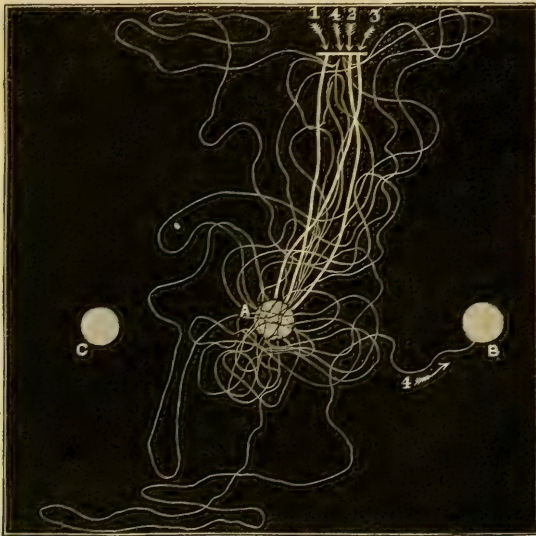
Hearing.

As regards their sense of hearing, I have in my previous paper recorded my unsuccessful experiments in this direction. Approaching an ant which was standing quietly, I have over and over again made the loudest and most shrill noises I could—using a penny pipe, a dog-whistle, a violin, as well as the most piercing and startling sounds I could produce with my own voice, but without effect. At the same time I by no means would infer from this that they are really deaf, though it certainly seems that their range of sounds is very different from ours. We know that certain

allied insects produce a noise by rubbing one of their abdominal rings against another. Landois is of opinion that ants also make sounds in the same way, though these sounds are inaudible to us. Our range is, however, after all very limited, and the universe is probably full of sounds which we cannot perceive. There are, moreover, in the antennæ of ants certain curious organs which may be of an auditory character.

These consist of three parts, a small spherical cup, opening to the outside, a long narrow tube, and a hollow body, shaped

Fig. 7.



Another tracing showing a similar Experiment. 1, 2, 3, the direct broad lines towards A; and 4, the complicated track made when reservoir of larvæ was removed to B.

like an elongated clock-weight. They are about 10 in number, and may serve to increase the resonance of sounds, acting, in fact, to use the words of Prof. Tyndall, who was good enough to look at them with me, like microscopic stethoscopes. Several of the other segments of the antenna also contain one of these curious organs.

Dependence on Slaves.

Huber mentions that the Amazon ants (*Polyergus rufescens*) are

so dependent on their slaves as to perish in two or three days if separated from them. That this is the case, has been shown by subsequent observers. It is no use giving them food—say honey; they will not touch it. Or rather, they walk carelessly over it, smear their legs, and die, if a slave is not put in to clean and dry them. I found, however, that I could keep even a single *Polyergus* alive for more than three months by giving her a slave for about an hour a day to attend on and feed her. I have one at this moment which has been so treated since November, and which is still alive and well*.

Division of Labour.

I mentioned in my last paper that in the autumn of 1875 I noticed an ant belonging to one of my nests of *F. fusca* out feeding alone. The next day the same ant was again out by herself, and for some weeks no other ant, so far as I observed, came out to the food. I did not, however, watch her with sufficient regularity. This winter, therefore, I have kept two nests under close observation, having arranged with my daughters and their governess, Miss Wendland (most conscientious observers), that one of us should look at them once an hour during the day. One of the nests contained about 200 individuals, the other, a nest of *P. rufescens* with the usual slaves, about 400. The mistresses themselves never come out for food, leaving all this to the slaves.

We began watching on the first of November, but did not keep an hourly register till the 20th, after which date the results are given in the following tables. Table No. 1 relates to the nest of *F. fusca*, and the ants are denoted by numbers. The hours at which we omitted to record an observation are left blank; when no ant was at the honey, the square is marked with an 0. An ant, marked in my register as No. 3, was at this time acting as feeder to the community.

The only cases in which other ants came to the honey were at 2 P.M. on the 22nd Nov., when another ant came out, whom we registered as No. 4, another on the 28th, registered as No. 5. Other ants came out occasionally, but not one came to the honey (except the above mentioned) from the 28th Nov. till the 3rd Jan., when another (whom we registered as No. 6) began feeding. After this a friend visited the honey once on the 4th, once on the 11th, and again on the 15th, when she was registered as No. 7.

* April 15. She is still well.

Table No. 2 is constructed in the same way, but refers to the nest of *Polyergus* and *F. fusca*. The feeders in this case were, at the beginning of the experiment, those known to us as Nos. 5, 6, and 7. On the 22nd Nov. a friend, registered as No. 8, came to the honey, and again on the 11th Dec. ; but with these two exceptions the whole of the supplies were carried in by Nos. 5 and 6; with a little help from No. 7.

Thinking now it might be alleged that possibly these were merely unusually active or greedy individuals, I imprisoned No. 6 when she came out to feed on the 5th. As will be seen from the table, no other ant had been out to the honey for some days ; and it could therefore hardly be accidental that on that very evening another ant (then registered as No. 9) came out for food. This ant, as will be seen from the table, then took the place of No. 6, and (No. 5 being imprisoned on the 11th Jan.) took in all the supplies, again with a little help from No. 7. So matters continued till the 17th, when I imprisoned No. 9, and then again, *i. e.* on the 19th, another ant (No. 10) came out for the food, aided on and after the 22nd by another, No. 11. This seems to me very curious. From the 1st Nov. to the 5th Jan., with two or three casual exceptions, the whole of the supplies were carried in by three ants, one of whom, however, did comparatively little. The other two are imprisoned, and then, but not till then, a fresh ant appears on the scene. She carries in the food for a week, and then, she being imprisoned, two others undertake the task. On the other hand, in Nest 1, where the first foragers were not imprisoned, they continued during the whole time to carry in the necessary supplies.

The facts therefore certainly seem to indicate that certain ants are told off as foragers, and that during winter, when little food is required, two or three are sufficient to provide it.

TABLE I. (continued).

Date.	6.30.	7.	8.	9.	10.	11.	12.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.
Jan. 8...	...	0	0	N 5	N 5 & 6	0	0	0	0	N 3	0	0	0	0	N 5	0	N 5
9...	0	0	0	0	0	0	0	0	...	0	0	0	0	...	0	0	0
10...	0	0	N 3	0	0	0	...	0	N 3	0	0	0	0	0	0	0	0
11...	...	0	N 6	N 3	0	0	0	0	Friend feeding	0	0	0	0	0	0	0	0
12...	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13...	0	0	0	0	0	...	0	0	0	0	0	0	0	0	0	0	0
14...	0	N 3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15	0	0	0	0	0	0	Friend marked	0	0	0	0	0	0	0	0	0	0
16...	0	0	0	0	0	0	N 7	0	0	0	0	0	0	0	0	0	0
17...	...	0	N 7	N 7 & 3	0	N 7	N 3	0	0	0	0	N 7	0	0	0	0	0
18...	0	N 6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
19...	0	0	N 6	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20...	...	0	0	0	0	0	0	0	0	N 6	0	0	0	0	0	0	0
21...	0	N 6	0	N 3	0	...	...	0	0	0	0	0	0	0	0	0	0
22...	0	N 6	0	0	0	0	0	0	N 6	0	0	0	0	0	0	0	0
23...	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
24...	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
25...	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
26...	0	0	0	0	0	N 3	0	0	0	0	0	0	0	0	0	0	0
27...	...	0	0	0	0	0	0	0	0	...	0	0	0	0	0	0	0
28...	0	0	Friend	0	0	0	0	0	0	0	0	0	0	0	0	0	0
29...	0	0	N 8	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			N 8	0	0	0	0	0	0	N 8	0	0	0	0	0	0	0

TABLE II.—*Slaves of Polyergus.*

Date.	6.30.	7.	8.	9.	10.	11.	12.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.
Nov. 20...	N 5	0	0	0	0	0	N 5	0	0	N 5	N 5	N 5	0	N 6	N 7	0	0
21...	0	0	0	N 5	0	0	N 5	0	...	...	...	0	0	0	0	0	0
22...	Friend marked	N 5	N 7	0	0	N 5	N 7	N 5	0	0	N 5	0	N 5	0	0	0	0
23...	N 8	0	N 5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
24...	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
25...	0	0	0	0	0	0	N 5	N 5	0	N 5	0	0	0	0	0	0	0
26...	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
27...	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
28...	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
29...	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30...	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dec. 1...	...	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2...	0	N 6	0	0	0	0	N 6	0	0	N 6	0	0	0	0	0	0	0
3...	0	0	0	0	0	0	N 6	0	0	0	0	0	0	0	0	0	0
4...	0	0	0	0	0	0	N 7	0	0	N 6	0	0	0	0	0	0	0
5...	...	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6...	...	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7...	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8...	0	N 6	N 6	0	0	0	N 6	N 6	0	0	N 6	0	0	0	0	0	0
9...	N 6	N 6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10...	...	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11...	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Friend.

TABLE II. (continued).

Date.	6.30	7.	8.	9.	10.	11.	12.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.
Jan. 5...	0	0	0	0	0	0	0	Impris. N 6	0	0	0	0	0	0	0	0	0
6...	0	0	0	0	0	0	0	0	0	0	...	...	...	0	0	Friend feeding	0
7...	0	0	0	0	0	...	...	0	0	0	0	0	0	0	0	0	0
8...	...	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9...	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10...	Friend marked N 9	0	0	0	0	0	...	0	0	0	0	N 9	N 7	N 9	0	N 5&9	0
11...	...	0	0	Impris. N 5	0	0	0	0	0	0	0	0	0	0	0	0	0
12...	0	N 9	0	0	0	0	0	0	0	0	0	0	N 9	0	0	0	N 9
13...	0	N 9	0	0	0	...	0	0	0	0	0	0	0	0	0	0	N 9
14...	0	0	0	0	0	0	0	0	0	0	N 9	0	0	0	0	N 9	0
15...	0	0	0	0	0	0	0	0	0	0	0	N 9	0	N 9	0	N 9	0
16...	N 9	0	0	0	0	0	0	0	0	0	0	N 9	N 9	N 9	0	0	N 9
17...	...	0	0	0	0	0	0	Impris. N 9	0	0	0	0	0	0	0	0	0
18...	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
19...	0	0	Friend marked N 10	0	0	0	N 10	0	N 10	0	N 10	0	0	0	0	0	0

20...	...	0	0	0	0	0	0	0	0	0	0	0	N 7	0	...	0	0	0
21...	0	0	0	0	0	...	...	0	0	0	0	0	0	Impris. N 7	...	N 10	0	0
22...	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N 11	0	0	N 11
23...	0	0	N 11	0	0	0	0	0	0	0	0	0	N 11	0	Friend marked N 12	N 10	0	0
24...	N 11	0	0	0	0	0	0	0	0	0	0	N 11	0	0	...	N 11	0	0

I now put back No. 7.

25...	0	N 11	0	N 7	0	0	N 11	0	0	0	N 11	0	N 11	N 11	0	0	0
26...	0	0	0	0	0	0	0	0	0	...	0	0	N 11	0	0	0	0
27...	...	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

I put back Nos. 5 and 6.

28...	N 11	0	0	0	0	0	0	0	0	0	0	N 5	0	0	N 12	0	0
29...	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30...	0	N 6	0	0	N 6	0	N 6	0	N 6	0	0	N 6	0	0	0	0	0
31...	0	0	0	0	0	0	0	0	0	0	0	0	N 6	0	0	0	0

TABLE II (continued).

Date.	6.30	7.	8.	9.	10.	11.	12.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.
Feb. 1...	0	0	0	0	0	0	0	0	0	0	0	0	N 11	0	N 6	0	0
2...	0	0	0	0	0	0	0	0	0	...	0	0	N 11	0	0	0	0
3...	...	0	0	0	0	0	0	0	0	0	0	0	N 6	...	0	0	0
4...	0	0	0	0	0	0	0	0	0	0	N 6	0	0	0	0	0	0
5...	0	0	0	0	0	0	0	0	0	...	0	0	0	0	0	0	0
6...	0	0	0	0	0	0	N 11	0	0	0	0	0	0	0	0	0	N 11
7...	0	0	0	0	0	0	0	N 11	0	0	N 11	N 12 & 6	0	0	0	0	0
8...	N 11	0	0	N 12	N 11	0	N 12	0	N 11	0	0	0	N 7	N 11	0	0	N 6
9...	0	N 11	0	0	0	0	N 11	0	0	0	0	0	0	0	0	0	0
10...	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11...	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12...	0	0	0	0	0	0	0	0	N 11	0	N 11	0	0	0	N 10	N 11	0
13...	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N 10	0	0
14...	...	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15...	0	0	0	0	0	0	0	0	N 11	0	0	0	0	0	0	0	0
16...	...	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
17...	0	0	0	0	0	0	0	...	0	0	0	0	0	0	0	N 11	0
18...	0	0	0	0	0	0	...	0	0	0	0	0	0	0	0	N 11	0
19...	0	0	0	0	0	0	0	N 11	0	0	0	0	0	0	0	N 11	0
20...	...	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
21...	...	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
22...	...	0	0	0	0	0	0	...	0	0	0	0	0	0	0	0	0
23...	...	0	0	0	0	0	0	0	0	0	...	0	0	0	0	0	0
24...	...	...	...	0	0	0	0	0	0	0	0	0	0	0	0	0	N 12

With the permission of the Council I have in this case also added the following, so as to extend the observations to three months.

Parthenogenesis in Ants.

Although the workers rarely lay eggs, still they do so occasionally, among ants as well as among bees and wasps. In the two latter groups these virgin eggs always produce drones; and the same will probably be found to be the case with ants also. I have a nest of *Formica cinerea* which I brought from Castellamare in December 1875, and which has no queen: nevertheless eggs were laid in it last spring, and these eggs produced winged individuals only, all, I believe, males; but unfortunately they emerged one day when I was away from home, and I lost the opportunity of examining them carefully. None of the eggs, however, produced workers.

Parasites of, and on, Ants.

The curious blind Woodlouse (*Platyarthrus Hoffmannseggii*) is very common in ants' nests in my neighbourhood. I have, however, never seen the ants take the slightest notice of them. Moreover, when my ants migrate from one nest to another, if the nests are at a little distance apart, the *Platyarthri* remain behind. I am disposed to think that they are mere scavengers.

On the 14th of October I observed that one of my ants had a mite attached to the underside of its head. The mite was almost as large as the head, and must have been very inconvenient. The ant could not remove it herself. She never came out of the nest, so that I could not do it for her; and none of her own companions from that day to this (1 Feb.) have thought of performing this kind office. I have also observed specimens of a minute red Mite, which I believe to be new, in nests of *Lasius flavus*.

Certain species of Diptera, belonging to the family Phoridae, are also parasitic on ants. I have forwarded them to Mr. Verral, who finds that some of them are a new species of the genus *Phora* and that among them is also the type of a new genus, which he proposes to call *Platyphora*, doing me the honour of naming the species after me. I subjoin his descriptions as a separate paper or appendix to my own.

In conclusion I wish to acknowledge the valuable assistance which I have received from my wife and daughters and their governess, Miss Wendland. Without their aid I could not have carried out the continuous observations above recorded.

Having had some enlarged drawings made, for my own convenience, of several specimens of the ants which I had been

watching, it was suggested to me that figures of these same, though not new to entomologists, might nevertheless be desirable to those interested in the subject. In the Plate each figure is considerably enlarged, but the actual dimension is expressed by scale alongside.

EXPLANATION OF PLATE XVII.

- | | |
|--|--|
| Fig. 1. <i>Polyergus rufescens</i> .
2. <i>Formica sanguinea</i> .
3. — <i>fusca</i> . | Fig. 4. <i>Atta barbara</i> (worker major).
5. Do. (worker minor)
6. <i>Strongylognathus testaceus</i> . |
|--|--|

Description of a new Genus and Species of Phoridae parasitic on Ants. By G. H. VERRAL, Esq., Memb. Entom. Soc. Communicated by Sir JOHN LUBBOCK, Bart., F.L.S., &c.

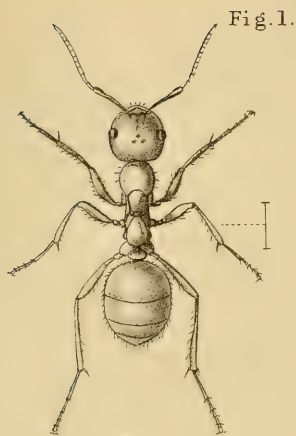
[Read February 1, 1877.]

THROUGH my friend Mr. Frederick Smith, of the British Museum, Sir John Lubbock has kindly forwarded for my examination and determination certain specimens of Dipterous insects said to have been found parasitic on species of ants, which latter he has been studying with care as to their habits. Having given considerable attention to the family Phoridae, I was agreeably surprised to find the parasitic specimens to be forms new to science. One of these is a new species of the genus *Phora*; the other I regard as possessing characters *sui generis*, and hence define it under the generic title *Platyphora*, at the same time bestowing on the species the name of the discoverer, who worthily pursues entomological researches, spite of many pressing public engagements.

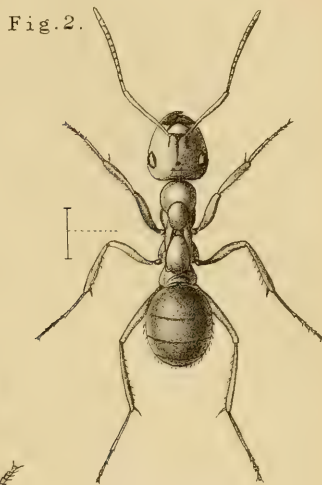
The subjoined descriptions embrace the diagnostic peculiarities of the insects in question.

PHORA FORMICARUM, n. sp. Nigro-cinerea, fronte setosa, caniculata; antennis mediocribus, cinereis; palpis magnis, flavis; halteribus flavidis; pedibus totis pallide flavis, inermibus, tibiis intermediis unicalcaratis, posticis modice dilatatis; alis subhyalinis, nervo secundo simplici, nervulis vix undulatis. Long. vix $\frac{1}{2}$ lin.

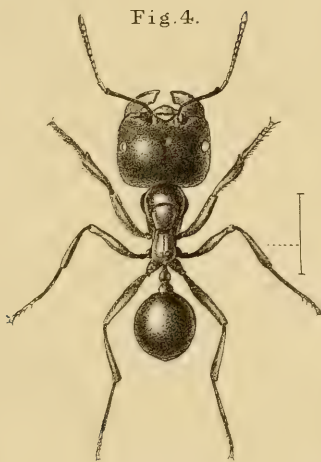
Frons broad, grey, bristly, two large bristles being close to the eye-margin; down the centre is a deep impressed channel, which at its lower



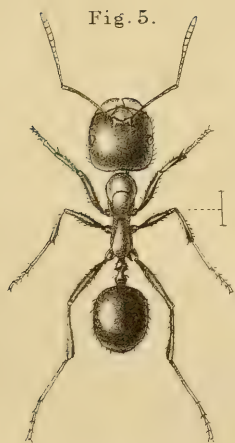
Polyergus
rufescens



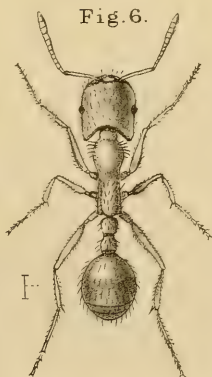
Formica
sanguinea.



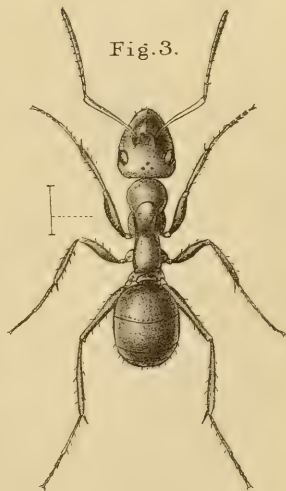
Atta barbara.
(worker major.)



Atta barbara.
(worker minor.)



Strongylognathus testaceus.



Formica
fusca.